CSCE 230 – Lab 5: Assembly Input and Output

Due: 11:59PM, Sep 26 (Tuesday)

Objectives

- ❖ Learn how to read and write the input and output of DE10 Lite boards
- ❖ Learn the basic idea of processor polling
- ❖ Learn how to show a decimal number on seven-segment displays

Useful References on Canvas

- ❖ Lecture notes for Chapter 3 and Appendix B
- ❖ Altera DE10-Lite Computer Document
  - ➢ Since you are using the DE10 Lite then the Red LEDs will be split for the slider switches and the 2 push buttons. This will require some bit masking.

Lab: Assembly Input and Output

First, please create a new project as follows.
- Create a new project directory. If you are using the lab computers, it is more convenient to create a new project directory in C:\temp (after the lab, please backup your files to your Z: drive)
- In your project directory, create an empty text file using any text editor, and name it lab5.s or any other names, but the file extension should be .s
- Open the Altera Monitor program
  - ○ Menu "File" → "New Project"
  - ○ In the "New Project Wizard",
    - ▪ Select your project directory and specify a project name, and then click "Next".
    - ▪ Select system "**DE10 Light Computer**" (because we will use the division instruction), and then click "Next"
    - ▪ Select program type "Assembly Program", and then click "Next"
    - ▪ Add your lab5.s file into the project, and then click "Next"
    - ▪ Use the default system parameters, and then click "Next"
    - ▪ For the memory settings, use the default SDRAM memory device, set .text to 0 and set .data to 0x400 (does not matter for this lab), and then click "Finish"

Then, write a single assembly program to complete the following tasks.

- Task 1 (easy): Please turn on/off the upper two red LED lights LEDR(9&8) according to the corresponding pushbutton KEYi (only KEY0 and KEY1).
    - KEYi is being pushed: LEDR(i+8) is on
    - KEYi is released: LEDR(i+8) is off
    - Note: All other red LED lights (i.e., LEDR0, LEDR4, …, LEDR7) are unchanged.

- Task 2 (easy): Please turn on/off the lower eight red LED lights LEDRi according to the corresponding slider switch SWi (i.e., SW0, SW1, …., and SW7…skipping SW8&9).
    - SWi in the top position (toward the center of your board): LEDRi is on
    - SWi in the bottom position (toward the edge of your board): LEDRi is off

- Task 3 (hard): Please show the decimal number corresponding to the ten slider switches on the lower four seven-segment displays (i.e. HEX3, HEX2, HEX1, HEX0).
    - For example, if slider switches are placed in the following positions, then the seven-segment displays show decimal number 3 corresponding to binary number 0000000011
        - SW1, SW0: top position
        - All other slider switches: bottom position
    - For example, if slider switches are placed in the following positions, then the seven-segment displays show decimal number 512 corresponding to binary number 1000000000
        - SW9: top position
        - All other slider switches: bottom position
    - For example, if slider switches are placed in the following positions, then the seven-segment displays show decimal number 1023 corresponding to binary number 1111111111
        - All slider switches: top position

- Overall hint:
    - You may implement all three tasks in a big loop
    - At the beginning of the loop, read the current values of slider switches and push buttons
    - Then update the red LED lights for keys, red LED lights for switches, and seven-segment displays.

- Hint for task 3:
    - First, you need to convert a binary number (i.e., SW9,…,SW0) to four decimal digits
        - Basic idea: repeatedly divide the binary number by decimal number 10, and the remainder at each step is a decimal digit
        - Division instruction:
            - ## div ri, rj, rk
            - Finally, ri is the resulting quotient when dividing rj by rk

- Find the remainder:
  - div ri, rj, rk
  - mul rm, ri, rk
  - sub rm, rj, rm
    - finally, rm is the remainder when dividing rj by rk
- Next, you need to set the four seven-segment displays according to the four decimal digits. The following table shows the binary and hexadecimal values of a seven-segment display for each decimal digit.

Decimal digit	Seven segment 6543210	Seven segment value (Hex)
0	0111111	0x3F
1	0000110	0x06
2	1011011	0x5B
3	1001111	0x4F
4	1100110	0x66
5	1101101	0x6D
6	1111101	0x7D
7	0000111	0x07
8	1111111	0x7F
9	1101111	0x6F

Finally, please answer the questions on Canvas, where you need to upload a photo as required below.
- Place the slider switches to the following positions
  - All slider switches: top position
  - then lower eight red LED lights should be turned on
  - then the seven-segment displays should show decimal number 1023
- Push pushbutton KEY1
  - then the red LED light 9 should be turned on, red LED light 8 should be off, and all other red LED lights should be turned on based on the switches 7 down to 0.
- While placing the slider switches to the required positions and pushing pushbutton KEY1 by one hand, please use your other hand (or the hand of another student) to take a photo of your board clearly showing all red LED lights (except LED 8), seven-segment displays, slider switches, and pushbuttons.